

□ Using Portfolios to Fulfill ISTE/NCATE Technology Requirements for Preservice Teacher Candidates

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Abstract

The International Society for Technology in Education (ISTE) has developed computer/technology guidelines for all teachers. These were approved by the National Council for Accreditation of Teacher Education (NCATE) as a part of the requirements for those seeking teacher certification in computer literacy, computer science education, and those seeking MA degrees in educational computing and technology. In addition, NCATE's new Unit Accreditation guidelines require integration of technology into teacher education programs. For most teacher education programs, these guidelines are welcome and will serve as a catalyst for preparing teacher candidates to be technologically competent. However, many teacher education programs cannot add additional courses to their curriculum. One way to overcome this obstacle is to require the infusion of technology across the teacher education curriculum and use portfolios to evaluate the success of teacher candidates in fulfilling the ISTE/NCATE guidelines. This article describes the successful implementation of a technology portfolio process and suggests activities to include in such a portfolio.

The International Society for Technology in Education (ISTE) has developed a set of foundations guidelines that all teacher education candidates should fulfill as foundational to their preparation (ISTE, 1992; Taylor & Wiebe, 1994; Wetzel, 1993). While the National Council for Accreditation of Teacher Education (NCATE) has not incorporated these guidelines into their Unit Accreditation Guidelines (NCATE, 1994), they are included in NCATE-approved teacher preparation programs for middle and high school computer literacy teachers and high school computer science teachers. (NCATE, 1993). In addition, recently adopted ISTE-recommended changes in NCATE's Unit Accreditation Guidelines (NCATE, 1994) require that teacher education programs thoroughly integrate technology into their programs (Thomas, 1994). The ISTE/NCATE foundations guidelines intend to provide teacher candidates with the knowledge, skills, and attitudes they need to be effective technology-using teachers. The ISTE/NCATE guidelines call for teacher candidates to have either courses or experiences that will help them do the following:

- Use technology for personal and professional productivity.
- Acquire both the content and pedagogical understanding needed to teach with computer-based technologies.

- Gain knowledge about the impact of technology on schools and society.

In fact, these guidelines have come to serve as national standards (Taylor & Wiebe, 1994) and are often more comprehensive, inclusive, and current than many state standards for certification or graduation from teacher preparation programs.

Many colleges and universities do not have specific preparation programs in the area of educational computing and technology and have not allocated resources or developed courses or curriculum that meet ISTE/NCATE standards (Thomas, 1994). This is especially true in states that do not require computer competency for teacher certification. However, with NCATE's increased focus on technology in their new Unit Accreditation Standards (NCATE, 1994), the thirteen ISTE guidelines serve as a guidepost for the preparation of teachers in a technological age. For most teacher education programs, these guidelines are welcome and will serve as a catalyst for increasing and/or improving the preparation of teacher candidates who are technologically competent as they begin their teaching careers.

Wetzel (1993) has suggested that the best way to meet the ISTE/NCATE standards is through the combination of a core computer literacy course model and an integration model with specific standards being met through one or the other of these two methods of instruction. The problem with this proposal is that many teacher education programs cannot add another course to their curriculum because of a variety of obstacles including allowable credit limits, other funding or accreditation priorities, or lack of faculty leadership or expertise. One way to overcome these obstacles and still meet the ISTE/NCATE standards is to require the infusion of technology across the teacher education curriculum (in methods and foundation courses, field placements, and in seminars attached to the field placements) and use portfolios as a means to assess the success of teacher candidates in fulfilling the ISTE/NCATE guidelines.

Teacher Education at UNCG

Teacher education at the University of North Carolina at Greensboro (UNCG) is an undergraduate program based on a Professional Development School (PDS) model. Teacher candidates spend four semesters in cohort groups, or teams, of 25-30 students who take all their methods and foundations courses together. They also spend ten hours every week in

designated PDS sites for three semesters prior to full-time student teaching during their final semester. Like many other teacher education programs around the country, UNCG has no room in its curriculum for another course. Furthermore, although North Carolina has no technology requirement tied to initial certification, it currently mandates computer-competency testing for inservice teachers. These competencies focus on two levels: knowledge of terms and knowledge about how to use technology for instructional purposes. Paper-and-pencil and hands-on assessments of keyboarding, word processing, and database and spreadsheet competencies for all eighth-grade students are also mandated. Implementing the ISTE/NCATE guidelines at the preservice level helps prepare new teachers to be at least as knowledgeable and competent about computer-based technology as the students and teachers they will work with when they graduate.

The goal of the UNCG teacher education program is to infuse technology throughout the preservice program. However, as with many teacher education programs, not all faculty who teach methods courses are proficient in using technology (OTA, 1995; Todd, 1993; Wetzel, 1993). Nevertheless, we want to prepare teacher candidates who can use technology appropriately in the classroom to meet their content and pedagogical objectives. In order to meet this need and to address accreditation goals, our preservice teacher education program has adopted the ISTE/NCATE guidelines and employs a portfolio assessment process as our way of both infusing and assessing these standards.

Technology Portfolios

Introduction and Description

A portfolio assessment process allows the completion of activities and the fulfillment of the ISTE/NCATE guidelines to be spread over the course of the four semesters that teacher candidates are enrolled in the elementary grades PDS program at UNCG. Various elements of the technology portfolio that are based on the ISTE/NCATE guidelines are incorporated into requirements for various methods courses, field experiences, and weekly seminars in a progressive sequence. For example, students fulfill guideline #4 about evaluating and using educational software and its associated documentation in each of their methods courses as they learn about effective teaching practices for each subject: math, language arts, reading, science, and social studies. In this way the preservice teacher candidates can evaluate computer-based applications and other software by comparing them with other teaching materials for a particular area of the curriculum. Furthermore, they can fulfill this guideline at a knowledge-and-awareness level by evaluating software available at the university or at their internship sites, and then have the opportunity to meet this guideline at a higher application-and-integration level in another field placement or during their student teaching semester.

Students also meet requirements such as "operating a computer system in order to utilize software," "demonstrating skill in using word processing, database, spreadsheet, and print/graphic utilities," and "using computer-based technologies to access information to enhance personal and professional productivity" (ISTE/NCATE competencies #1, #9 and #12—see Figure 1) in a progressive set of portfolio requirements that include using word processing to write journals about their field experiences, exchanging e-mail journal entries with peers about their field experiences and curriculum plans, and using the Internet to locate information and lesson plans that they can share with peers and use in their teaching. As the teacher candidates become more knowledgeable about ways to use computer-based technologies as tools for teaching and learning, they naturally begin to incorporate the technology into their work with children in their internships and during student teaching.

Neither NCATE nor ISTE has provided teacher-educators with specific details about exactly what each of the guidelines mean, how they can be fulfilled, or how they might be evaluated. However, the adoption of these guidelines provides a framework for teacher preparation programs to seek ways to meet these standards. At UNCG, the teacher candidates are presented with the ISTE/NCATE guidelines, a list of possible activities for fulfilling each guideline, and a set of suggested entries for their portfolios when they begin their teacher education program. Students can complete the suggested activities and meet the guidelines at three levels (see Figure 1). Though only Level One (Knowledge and Awareness) competency is required at the undergraduate level, teacher candidates fulfill many of the guidelines at Level Two (Application and Integration) by revisiting the guidelines and planning activities where they actually teach their students using computer-based technologies and software. Level Three (Infusion and Transformation) is a goal to strive for, but it is not one that very many preservice teacher candidates can meet because of their limited control over the curricula in their internship settings or in their student teaching placements. Nevertheless, it is a goal that many teacher candidates work toward and one that we intend to assess as we follow our graduates longitudinally into their induction years and beyond. In the meantime, their technology portfolios provide us with evidence of what they have learned about using computer-based technologies for teaching and learning and how they have addressed technology in the field.

Implementation and Assessment

The ISTE/NCATE guidelines and some suggested activities that our preservice teacher candidates at UNCG can undertake to demonstrate these computer competencies and skills follow. These suggestions are not exhaustive; they provide our teacher

ISTE/NCATE Competencies	Level One Awareness and Knowledge	Level Two Application and Integration	Level Three Infusion and Transformation
1. Operate a computer system in order to utilize software			
2. Evaluate and use computers and related technologies to support the instructional process			
3. Apply current instructional principles, research, and appropriate assessment practices to the use of computers and related technologies			
4. Evaluate and use educational software and associated documentation			
5. Demonstrate knowledge of uses of computers for problem solving, data collection, information management, communications, presentations, and decision making.			
6. Design student activities that integrate computing of a variety of grouping strategies and diverse student populations			
7. Integrate computer-based instruction in the curriculum			
8. Demonstrate knowledge of multimedia, hypermedia, and telecommunications activities to support instruction			
9. Demonstrate skill in using word processing, database, spreadsheet, and print/graphics utilities			
10. Demonstrate knowledge of equity, legal, and human issues of technology			
11. Identify resources for staying current in computer applications in education			
12. Use computer-based technologies to access information to enhance personal and professional productivity			
13. Apply technology to facilitate emerging roles of the learner and the educator			
NOTES			
COMMENTS			

Figure 1. Rubric for Technology Portfolio

candidates and methods professors with some ideas about how they might demonstrate competency with regard to each guideline. Other activities may be submitted by the teacher candidates in their portfolio to fulfill one or several of these requirements, and methods professors may either require or suggest specific activities to fulfill certain standards. Unlike other models for fulfilling computer competencies for preservice teachers, the responsibility (and also the success and sense of

ownership) of this portfolio process rests with the teacher candidates rather than with the faculty. Our requirement is that the teacher candidates write brief reflections to accompany each entry in their portfolio indicating the following:

- What guideline(s) each entry fulfills.
- What level the entry is meant to address (i.e., Level One, Level Two, or Level Three).

- What they have learned personally from doing each entry.
- How they foresee using each activity in their teaching.

Printed examples of their own or students' work showing how they have met each competency and their written reflections are required to support each portfolio entry.

Examples and suggestions for fulfilling ISTE/NCATE competencies at three levels follow.

Operate a Computer System in Order to Utilize Software

To fulfill this requirement at Level One, teacher candidates might write and print journal assignments, create a worksheet or handout for students, or develop and print a parent newsletter. To fulfill Level Two, teacher education students could demonstrate that they can operate a computer well enough to teach someone else how to do word processing (including saving, retrieving files, and printing) or how to use educational software, CD-ROMs, or a videodisc to gather information or learn something. At Level Three, preservice teachers need to show in their lesson plans or with student work that they regularly have their students use word processing for writing stories and reports, use databases for keeping student records, use spreadsheets or a gradebook program for keeping student grades, or use desktop publishing for communication with families.

Evaluate and Use Computers and Related Technologies to Support the Instructional Process

To fulfill this requirement at Level One, teacher candidates might document how technology is currently used in various areas of the curriculum using personal experiences from their internships or student teaching experiences and/or from their methods classes. For Level Two, teacher candidates could select and use a variety of technology (computers, modems, overhead projectors, videodiscs, videotape, cameras, synthesizers, films, tape recorders, etc.) in their teaching and document and critically evaluate how the technology they used supported their instruction in a lesson plan, journal entry, or in a written reflection on a videotaped lesson. To show Level Three competency, they could show examples in several areas of the curriculum that prove regular use of a variety of computer-based technologies with students, including lesson plans, unit plans, student work samples, and/or videotape examples as part of their portfolio entries.

Apply Current Instructional Principles, Research, and Appropriate Assessment Practices to the Use of Computers and Related Technologies

At the first level, teacher candidates could summarize articles in technology magazines and journals about how computers and other technologies are used in teaching a variety of subjects, compare and contrast the current and

potential uses of technology for instruction in a particular area of the curriculum, or join a listserv on the Internet and participate in ongoing discussions about technology for instruction, research, and assessment. To fulfill Level Two understanding, they could design a computer activity to serve as an alternative, performance-based assessment for a lesson or unit they teach, or design a rubric to evaluate a computer-based activity they have students undertake as part of a lesson or unit they teach. For Level Three, teacher candidates could conduct an action research project that involves inquiry into and assessment of their classroom uses of computer-based technology and software or how a variety of software can be used to support different learning styles; for example, they could study gender issues and how computers are used by students.

Evaluate and Use Educational Software and Associated Documentation

At Level One, teacher candidates could write narrative evaluations of at least two pieces of software in each of the content areas (math, science, social studies, and reading/language arts), including a description of the program and its documentation, a list of the program's strengths and weaknesses, and ways to integrate it into teaching. For Level Two, they might use educational software in a lesson or unit they plan and teach and evaluate its effectiveness in a written reflection. For Level Three understanding, teacher candidates could present evidence of regular use of educational software in a variety of curriculum areas, such as word processing and desktop publishing in language arts, books on CD-ROM in reading, databases and simulations in social studies, Logo or other problem-solving software in math, and probeware in science.

Demonstrate Knowledge of Uses of Computers for Problem Solving, Data Collection, Information Management, Communications, Presentations, and Decision Making

To show Level One competency, teacher candidates could use and evaluate problem-solving software programs, use probeware in science for data collection, use a database management program to create a database of children's literature, use a presentation package and/or a word processor to make a set of overheads or handouts, create a budget or a sample gradebook on a spreadsheet, apply for an e-mail address and send messages to colleagues, monitor several listservs and write about the discussions they generate, or participate in a computer-based simulation. For Level Two, they could do some of the above activities with their students in their internship placements or their student teaching semester and write a reflective analysis of the benefits and costs of each activity for teaching and learning. Level Three understanding can be demonstrated by presenting evidence that technology has infused

and transformed their curricula and teaching methods by using a variety of computer-based tools and software as a regular part of their instruction to help students learn to make decisions, solve problems, gather data, manage information, communicate, and make presentations.

Design Student Activities That Integrate Computing for a Variety of Student Grouping Strategies and for Diverse Student Populations

For Level One competency, teacher candidates might develop a list of software appropriate for students in classes with specific needs; observe, interview teachers, and critically evaluate the uses of integrated learning systems (ILS) for instruction; or participate in the Write to Read Program. To show Level Two understanding, teacher candidates could videotape their teaching using presentation tools for whole-class instruction, computer(s) with small groups, and a computer one-on-one with a student. Teacher candidates could demonstrate Level Three competency by showing, through lesson or unit plans, videotapes, and written reflections, that they regularly employ computer-based technologies to meet the diverse needs of their students, including students with special learning problems and academically gifted students, or demonstrate how they use computers with individuals, small groups, as learning centers, and for whole class instruction as a part of their regular teaching practices.

Integrate Computer-Based Instruction in the Curriculum

To demonstrate understanding of this principle at the knowledge level, teacher candidates could write a lesson or unit plan that integrates computer-based technology with their goals and objectives. For Level Two, teacher candidates could teach programming, geometry, or measurement with LOGO; process writing with a word processor or desktop publishing program; gathering and analyzing science data with probeware; science concepts using videodiscs; or social studies concepts using simulations. To show Level Three comprehension, teacher candidates could document their integration of a wide variety of computer-based technology (hardware and software) into their curricula with examples of student-generated products and their own reflections on the processes you use.

Demonstrate Knowledge of Multimedia, Hypermedia, and Telecommunications Activities to Support Instruction

For Level One competency, teacher candidates could develop a set of overheads with presentation software, use the Internet to find lesson plans or background information for a lesson, explore a variety of browsing tools (e.g., Gopher, Mosaic, Yahoo, Netscape, etc.) on the World Wide Web to gather materials for teaching, repurpose a videodisc to use as part of a class presentation or for student use in a lesson

or unit, teach a lesson using the videodiscs from *Windows on Science*, or develop a *HyperCard* or *HyperStudio* lesson or activity for presentation to their students. To demonstrate Level Two understanding, teacher candidates could teach their students how to use multimedia, hypermedia, and telecommunications and present examples of their work as evidence that they have fulfilled this competency. For Level Three, they could infuse a variety of multimedia, hypermedia, and telecommunication experiences into their regular curricula and document these with lesson or unit plans, videotapes, and written reflections.

Demonstrate Skill in Using Word Processing, Database, Spreadsheet, and Print/Graphic Utilities

To demonstrate competency at Level One, teacher candidates might present evidence that they can operate these application tools for personal or professional uses or locate appropriate activities in the North Carolina Computer Skills Curriculum guide for use at their grade levels in each of these areas. To show Level Two competency, teacher candidates could design specific lessons and/or units to introduce and teach their students how to use each of these applications or teach specific lessons from the North Carolina Computer Skills Curriculum guide and evaluate their effectiveness. For Level Three competency, they could show how they regularly use a variety of tool software to support instruction or document regular use of lessons and activities from the North Carolina Computer Skills Curriculum guide with your students.

Demonstrate Knowledge of Equity, Ethical, Legal, and Human Issues of Technology

Teacher candidates could demonstrate Level One competency by writing an essay about a topic like gender equity, privacy issues, piracy, copyright laws, environmental hazards of technology, or any other issues related to the equity, ethical, legal, or human issues surrounding technology; by using and evaluating the *HyperCard* Ethics stack (shareware); by using and evaluating the *HyperStudio* Gender Equity stack (an interactive, multimedia program for the Macintosh computer on CD-ROM developed locally by the author to educate teachers about gender equity issues in elementary math, science, and technology); or by participating in class discussions about these issues. For Level Two competency, teacher candidates could plan several lessons or a unit for teaching students about one of these topics (computer privacy, computer piracy, copyright laws, gender equity) or use and discuss the *HyperStudio* Gender Equity stack designed for third- through sixth-grade students (a companion stack bundled with the CD-ROM for teachers). To show infusion-level competency, teacher candidates could write a position paper that describes specific examples of how they have

addressed equity, ethical, legal, and human issues of technology in their own teaching situations or present a series of lesson or unit plans that show how they have addressed equity, ethical, legal, and human issues of technology in their teaching.

Identify Resources for Staying Current in Computer Applications in Education

For Level One competency, teacher candidates could gather, read, and share articles from current technology periodicals or the Internet on a topic of interest related to computer technology; read and write an analysis of a book about technology (fiction or nonfiction); or join, read, and print out some of the exchanges on a listserv related to current issues in technology and education. To demonstrate Level Two understanding, they could find and apply information from a technology magazine or the Internet to their own teaching situations or join and contribute to the discussion on a listserv related to technology and education. Teacher candidates could demonstrate Level Three understanding of this principle by designing and conducting an action research project to answer questions they have about using technology in their own classrooms or by writing an article to submit to a technology magazine about ways they have used technology successfully in their classrooms to support instruction.

Use Computer-Based Technologies to Access Information to Enhance Personal and Professional Productivity

To show Level One competency, teacher candidates could demonstrate that they can use the Internet or an online service to find information for a unit of study; use multimedia encyclopedias to gather background information, maps, or pictures to design a lesson or answer student questions; use other reference tools on CD-ROMs to enhance their own learning; or do an ERIC search or use other reference tools at the library. For Level Two, they could teach students how to use multimedia encyclopedias and other reference tools on CD-ROMs or the Internet. For Level Three competency, they could document in a portfolio containing printed examples, lesson or unit plans, and written reflections how they have used the following computer-based technologies to enhance their teaching and learning: tool software (including word processors, databases, spreadsheets, and print/graphics utilities), multimedia (including CD-ROMs and videodiscs), and telecommunications (including e-mail and the Internet).

Apply Technology to Facilitate Emerging Roles of the Learner and the Educator

Teacher candidates could demonstrate Level One understanding by applying Howard Gardner's work on multiple intelligences to show how a variety of software can accommodate individual strengths in these areas, identifying

appropriate hardware or software for students with different learning styles or with learning or physical handicaps, or developing a list of developmentally appropriate uses and computer-based activities for students at three different grade levels. To show Level Two competency, they could teach a lesson or unit that incorporates a variety of computer-based technologies to accommodate the various learning styles of their students or teach a lesson or unit that uses software, computers, and other technologies to explicitly address Gardner's multiple intelligences. For Level Three, teacher candidates could demonstrate and reflect on the ways they regularly and systematically use a variety of technology in their teaching practices to accommodate students and individualize instruction.

Assessment of the Technology Portfolio Process

Each semester, teacher candidates turn in their technology portfolios to be assessed with the three-level scoring rubric (see Figure 1) designed as a check-off and recording sheet for whether entries are met at Level One (Knowledge and Awareness), Level Two (Application and Integration), or Level Three (Infusion and Transformation). Portfolios are assessed individually by each teacher candidate's team leader, although some entries may have also been evaluated by a methods course instructor. Alternatively, teacher candidates conference individually with their team leader to present their portfolio for joint assessment of the teacher candidate's progress toward fulfilling the ISTE/NCATE standards. The point of this evaluation is to validate and encourage teacher candidates' progress toward expanding their knowledge of how computer-based technologies can support teaching and learning.

Teacher candidates report verbally during conferences and in the written reflections accompanying their technology portfolios that they feel more competent with technology each semester, more knowledgeable about the potential uses of technology in their teaching, and anxious to learn more and do more with their students in their field placements. Several anecdotal examples from written entries in the teacher candidate's portfolios at the end of their first year confirm these perceptions:

Mary: Using e-mail has been a new experience for me. The first few times that I tried to use it, I became very frustrated. Now I think I have the hang of it. I think this will be a great asset to me as a teacher, I can send messages to people that I may or may not know around the world. I can ask someone in another country for ideas on how to do a particular lesson. This allows endless sources of information. This technology will also help me when I am teaching my students to write a letter. I intend to have my older students write using

e-mail also. With this new technology it will be possible to communicate with people around the world.

Sam: My e-mail account is used primarily for communication.... I have demonstrated both the sending of and responding to messages on the account, as well as, forwarding messages. It is used for casual conversations, the transfer of journal entries written about classroom observations in my internship, and to share information with my team leader in my internship program. I also use the account to communicate with my professors and to receive information off the Internet. I have, on several occasions, used the system to share professional ideas with other teachers across the country. I think children should also be able to demonstrate similar uses of an e-mail account.

Tammy: I have had a great experience using the e-mail. It really has helped me not only academically but socially also. Since obtaining the e-mail account I was able to get many ideas for the use of technology in the classroom. I have explored with Gopher and successfully obtained an address for a friend at a university in Florida.... This was just a wonderful experience for me to be able to communicate.... I have also enjoyed being able to send my reflections to my colleagues without having to print it out and hand deliver it.... This may sound trivial but to a person who finds computers challenging it is a revelation! The experience has really been rewarding and I will continue to build upon the knowledge I have already accumulated.

Terry: One girl in my second grade class did a project on dinosaurs. Working together after school ... we listened to and watched tapes as she took down some important information. Later, with the help of her father ... we viewed a CD.... She printed certain pictures and included them in her project.... I am truly amazed at how technology has progressed over the past several years and can still be implemented with small children.... When I was in school we did not even have this kind of opportunity. Growing up I remember Atari and Commodore 64 computers. I never dreamed this type of progression would take place. The tape recorder seems of almost no value now...You can pop a CD into a computer, listen and see more information, and have the same notes printed out for you! ... It is just amazing what the touch of a few buttons can do these days. Technology plays a vital role in everyone's life; even small, seven-year old second graders. The little girl probably learned more about dinosaurs in a couple of

hours than I could have learned years ago in a few days. I can honestly say that I learned a few tricks myself. This little girl taught me something. Can you implement technology into an elementary classroom? You better believe it!

Tammy: I really got excited when I was using the spreadsheet program. It was a little hard to understand. However, after I got involved in the process I was able to enjoy it. I like the fact that the user would be able to do many mathematical operations with the spreadsheet such as adding, finding averages, and also using it to find standard deviations, etc. I feel like it could be integrated into different lessons in many ways.

Next Steps

The technology portfolio process has recently been adopted and adapted by the secondary teacher education program at UNCG. All secondary teacher education majors are required to take a three-credit multidisciplinary course that combines information about technology, multicultural education, and issues involving special education. The portfolio concept is used in this course for assessing technology competencies based on the ISTE/NCATE standards and for showing competency in the other topics in this course. Secondary students combine readings, time in the computer lab, and field experiences about integrating technology in subject matter instruction as they strive to fulfill all the NCATE/ISTE guidelines in this one-semester course.

One of the revisions to the elementary technology portfolio that needs to be made is the integration of technology into other required credential and certification courses that are not taught in the School of Education. For example, art, music, drama, and physical education methods courses are taught in their respective departments in other colleges around the university. Our goals and intentions for the technology portfolio process remain to be communicated to these methods faculty so that students can also demonstrate how technology is used in the arts and physical education. Some of these courses already use technology and teacher candidates may add this information and these experiences to their portfolios, while other courses are not yet addressing technology. Fortunately, the NCATE accreditation requirements will alert all faculty to this need and the portfolio process described in this article can become a means of documenting compliance.

Finally, some of the teacher candidates take the opportunity to create a multimedia teaching portfolio using *HyperStudio* during their second year in our program. They receive training in how to use the program as a multimedia

authoring tool in a week-long workshop prior to the start of their last year in our teacher education program and then participate in monthly Saturday workshops to develop electronic teaching portfolios. Entries in these multimedia portfolios encompass their entire teacher preparation program, including experiences with technology. For example, teacher candidates capture video from lessons they have taped to show themselves in action and scan student products from lessons they have taught. They use photographs and videos they have taken in their classrooms to show their students at work, their own teaching, and other examples of their efforts, such as bulletin boards or special projects they have created. These multimedia portfolios also include the teacher candidates' resumes, statements of their educational philosophies, and some of their lesson plans. They use the graphics and sound features of *HyperStudio* to annotate examples of their work with children. For example, they record descriptions and reflections about their teaching activities to accompany graphic images. Final products are pressed on a CD-ROM available to principals and other school personnel as the teacher candidates look for teaching positions.

Summary and Conclusions

This article has described a successful way to address the infusion of the ISTE/NCATE guidelines for technology-literate teacher candidates into a School of Education where a separate computer course is not feasible. Fulfillment of the thirteen ISTE/NCATE standards is spread across four semesters using this portfolio process. A three-tiered system of assessment requires all teacher candidates to complete the competencies at least at a knowledge-and-awareness level, but encourages many to apply and integrate their new knowledge by using technology in their field placements.

An additional benefit of the technology portfolio process described here is that it serves as a foundation for more advanced experiences with technology, such as the electronic teaching portfolios developed by teacher candidates.

References

International Society for Technology in Education Accreditation Committee. (1992). *Curriculum guidelines for accreditation of educational computing and technology programs*. Eugene, OR: Author.

National Council for Accreditation of Teacher Education. (1993). *Approved curriculum guidelines*. Washington, DC: Author

National Council for Accreditation of Teacher Education. (1994). *Standards, procedures, and policies for the accreditation of professional education units*. Washington, DC: Author

Taylor, H.G., & Wiebe, J.H. (1994). National standards for computer/technology teacher preparation: A catalyst for change in American education. *Journal of Computing in Teacher Education*, 10(3), 21-23.

Thomas, L. (1994). NCATE releases new unit accreditation guidelines: Standards and technology are included. *Journal of Computing in Teacher Education*, 11(1), 5-7.

Todd, N. (1993). A curriculum model for integration technology in teacher education courses. *Journal of Computing in Teacher Education*, 9(3), 5-11.

Wetzel, K. (1993). Models for achieving computer competencies in preservice education. *Journal of Computing in Teacher Education*, 9(4), 4-6.

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